P-58

The influence silicon dioxide nanoparticles on mechanical properties of erythrocyte and platelet membranes estimated by atomic force microscopy method

G.B Melnikova[1], E.E Konstantinova[1], T.N. Tolstaya[1], A.S. Petrovskaya[1], S.A. Chizhik[1], O.N. Shyshko[2]

[1]*A.V. Luikov Heat and Mass Transfer Institute of National Academy of Science of Belarus, 220072, Minsk, Belarus*
e-mail: galachkax@gmail.com

[2]*Belarusian State Medical University, Minsk, Belarus*

Silicon dioxide is widely used as excellent adsorbent, for production of different drugs, drugs carrier, and also has other applications. The research of interaction nanoparticles with biological cells is important, because not only the drug itself affects cell membrane, but also excipients do. The using of modern methods for nanoscale objects research allows to giving detailed information about changes after different action.

In our research the group of patients with average years 55 (50; 59) and type 2 diabetes mellitus (DM 2) were formed. These did not achieve compensation for HbA1c 9.1 (8.30, 10.4). Men and women were in same age, and they have DM 2 during last of 5–10 years.

Silicon dioxide nanoparticles (NP, Sigma – Aldrich, d = 10–20 nm) in physiological solution (C = 0.2 and 1 mg/ml) were used to affect on RBCs and platelets suspensions. Cells were incubated at room temperature during 40 and 60 minutes. After that suspensions of cells were fixed with glutaraldehyde on the mica plates. The influence of silicon dioxide nanoparticles on structure and mechanical properties of membranes blood cells by AFM method have been studied. We used standard silicon cantilevers (Mikromash, K= 3 N/m, R= 30 nm) for researching by atomic force microscope (NT-206, Belarus). Elastic modulus was calculated by Jonson-Kendall-Robertz model [1].

In early research we showed, that gold and polyacrylic acid nanoparticles do not influence on elastic modulus of RBCs membranes, results were based on AFM method data [2]. In this we found that cells membranes structure didn't change after incubation with NP. We supposed this associated with interaction NP to membranes structural element and shaping uniform structure with the cell. It was confirmed that in some cases aggregation stability of RBCs was decreased in NP presence. It is connected with adsorbance NP by cells and the result charge changing on erythrocytes surface and their aggregation.

The average elasticity modulus of initial RBCs membranes is 128.5 ± 10.0 % MPa and for platelets is 151.6 ± 10.0 % MPa, adhesion force is 23.0± 10.0 % and 26.0± 10.0 % nN, respectively. After cells incubation with silicon dioxide the elastic modulus changed for two types cells within experimental error. Changes of adhesion force are minor, however insignificant variations were found in the case of incubation RBCs with NP (c= 0.1 mg/ml) during 40 minutes and reached 22.0 % of initial values.

So, the obtained results can be used to develop methods for determining the properties of blood cells under various affects and pathologies.

The investigation performed within the Programs of State Research "Energy systems, process and technologies", project 2.2.

1. K.L. Johnson, K. Kendall, A.D. Roberts, *Proc. R. Soc. Lond.* **324**, 301 (1971).
2. G.B. Melnikova et al., *Series on Biomechanics* **29**, 12 (2015).